

935677

1200.

DEPARTMENT OF COMMERCE

PUBLIC LIBRARY

TECHNICAL NEWS BULLETIN

MAY 1927
DETROIT, MICH.

OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year (U. S.), 40 cents a year (Foreign). Address
"Superintendent of Documents, Washington, D. C."

Washington, May, 1927—No. 121

CONTENTS

Development of radio aids for the civil airways.

Meeting of American Physical Society.

Meeting of Metallurgical Advisory Committee.

Thermal expansion of nickel steels.

Changes in weights with changes in humidity.

Business precision test for watches.

Fire hazards from smoking.

Simplification of bolt and nut containers.

Simplification of billet stock for concrete reinforcement.

Simplified invoice form.

Management week.

Savings through simplification.

Third revision of specification for tires and tubes.

Improvement of skein test for strength of yarns.

Mangrove bark as tanning material.

Classification of paper freight-container bags.

Workability of concrete.

Rate of carbonation of lime plaster.

Further investigation of feldspar.

Fundamental qualities of some refractory clays.

New and revised bureau publications issued during April, 1927.

Recent articles appearing in outside publications.

DEVELOPMENT OF RADIO AIDS FOR THE CIVIL AIRWAYS

Shortly after the formation of the Aeronautics Branch of the Department of Commerce in July, 1926, a program of establishing aids to air navigation was begun. These aids are: Upper air weather information, airways lighting for night flying, and radio aids. The last named includes radiotelephony between airplane and ground, and a special radiobeacon system. They are as yet in a development status. The experimental work required to perfect and adapt them to the requirements of the civil airways is being done by the Bureau of Standards.

Four aircraft radiobeacon stations are now established or under construction in the United States. Two of these were established before the Department of Commerce entered this field of work; they are the station of the War Department at McCook Field, Dayton, Ohio, and that of the Ford Motor Co., at Dearborn, Mich. The other two are

the radiobeacons which form part of the experimental aeronautic radio stations established by the Bureau of Standards at College Park, Md., and Bellefonte, Pa. Research and development work have been in progress at the College Park station for some months, and construction work was begun at the Bellefonte station during April. Besides serving as laboratories to determine the best forms of radio aids for the civil airways, these two stations will be available to render actual radio service to the commercial air lines operating through these points after July 1. These lines are, respectively, the Pitcairn Co., operating the New York to Atlanta route, and the National Air Transport (Inc.), operating the New York to Chicago route. It is expected that similar stations will be established by the department at various other points on the airways of the country.

The radio aids to air navigation which are incorporated in the stations of the Bureau of Standards are three

in number, viz, the directive radiobeacon, the marker beacons, and radiotelephony. The directive beacon sends out a special type of radio beam by which the pilots are able to follow the designated course in total darkness or fog. The marker beacons are small radio-transmitting sets which are placed at intervals of about 25 miles along the route and supplement the directive beacon by serving as mileposts. The radiotelephone transmitting station is used to inform the pilots of weather conditions, landing places, and other navigational facts. In both the Bellefonte and the College Park installation, the radiotelephone transmitting station is located several miles from the radiobeacon station but is operated from a microphone located at the airport near the beacon station. Provisions are thus made for control of the whole system of radio aids by a single radio operator at the airport, who is also equipped with receiving apparatus for receiving from such airplanes as have transmitting sets. Wire-line connections are also provided at Bellefonte for coordination of these operations with the radiotelegraph communications between Bellefonte and other airports.

The bureau is carrying on this work with the cooperation of other Government departments, radio manufacturers, and wire-line companies, and the air-transport companies. One of the results of the work to date is the conclusion that radio aids to air navigation will require the use of specially armored cable on airplanes for the engine ignition systems. With this simple precaution taken in the construction or equipping of airplanes all three radio aids can be utilized by the use of a very simple receiving set on each airplane. For the experimental work at Bellefonte, one of the airplanes of the Post Office Department used in regular mail flights is being provided with shielding equipment.

While it is not expected that two-way telephony between airplanes and ground

will be widely used immediately, the importance of this development will eventually make it an everyday service. Recent experiments at College Park have been devoted to this. Using a 100-watt transmitting set on the airplane, conversations were readily held with persons on the ground at distances up to 50 miles. Not only was conversation carried on between the airplane and the operators at the College Park station, but, through the cooperation of the telephone company, connections were made with the regular exchange. Officials of the Bureau of Standards sat at their desks and conversed with the observer in the airplane. This system was personally inspected by Assistant Secretary MacCracken, who expressed himself as much pleased with the possibilities of the radiotelephone development after trying it in flight.

No publications have been prepared on this work and none are contemplated in the immediate future, since the system is still under development. Monthly announcements of the progress of the work are given in *Domestic Air News*, a monthly bulletin issued by the Aeronautics Branch, Department of Commerce.

MEETING OF AMERICAN PHYSICAL SOCIETY

The one hundred and forty-fifth regular meeting of the American Physical Society was held in Washington on April 22 and 23. For the first time in several years the meeting was not held at the Bureau of Standards, but in the new building of the National Academy of Sciences.

The following papers were presented by members of the bureau's staff:

Log, semilog, and uniform coordinator, by R. A. Castleman, jr.

Redetermination of the Newtonian constant of gravitation, by Paul R. Heyl.

Variation of gold-plated screw-knob weights with atmospheric humidity, by A. T. Pienkowsky and E. S. Fowle.

Thermal expansion of some nickel steels, by Peter Hidnert and W. T. Sweeney.

Zeeman-effect of the fine structure components of λ 2536 of mercury, by Walter A. MacNair.

The light-absorption of liquefied gases, by F. G. Brickwedde and W. A. MacNair.

Reproducible liquid filters for the determination of color temperatures of incandescent lamps, by Raymond Davis and K. S. Gibson.

X rays of long-wave length from a ruled grating, by F. L. Hunt.

Purification of helium, by J. Williamson Cook.

Progress of some of this work has been mentioned in previous numbers of the Bulletin. Considerable popular interest has been shown in Dr. Heyl's work on the redetermination of the constant of gravitation. In his paper he announced that one more decimal place has been added to the accepted value of this fundamental constant, the new value being 6.664×10^{-8} .

MEETING OF METALLURGICAL ADVISORY COMMITTEE

Forty metallurgists representing the American Society for Testing Materials, American Society for Steel Treating, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, Society of Automotive Engineers, American Electrochemical Society, American Chemical Society, American Foundrymen's Association, American Zinc Institute, American Railway Engineering Association, and American Ceramic Society met at the bureau on May 6 and 7, together with 20 representatives of other departments of bureaus of the Government and 40 Bureau of Standards representatives in the annual meeting of the Metallurgical Advisory Committee.

The members and guests present included, besides professors of metallurgy and consulting metallurgists, those connected with many branches of the metallurgical industry. Metallurgists con-

nected with makers of iron and steel, as the American Cast Iron Pipe, American Rolling Mill, American Sheet and Tin Plate, Bethlehem, Byers, Carpenter, Crucible, Midvale, National Tube, and Taylor-Wharton companies; with ferro-alloy makers, as the Union Carbide and Carbon and the Vanadium Corporation; with makers of nonferrous metals and alloys, as the Aluminum Co., American Brass Co., Bunting Brass, Bridgeport Brass, International Nickel, Lumen Bearing, Magnus Metal, National Lead, and Scoville manufacturing companies; and with users of alloys, such as Bell Telephone, Cleveland Twist Drill, Crane, Delco Light, Detroit Edison companies, the Pennsylvania Railroad, Porcelain Enamel & Manufacturing Co., Western Electric, and Westinghouse Electric & Manufacturing companies, were present.

Other Government departments or bureaus, the representatives of which attended were: Army (Assistant Secretary's Office and Ordnance); Department of Commerce, iron and steel division of the Bureau of Foreign and Domestic Commerce, Bureau of Mines, and National Committee on Metals Utilization; Interstate Commerce Commission (Bureau of Safety); National Advisory Committee for Aeronautics; Navy (Bureau of Construction and Repair, Engineering, Yards and Docks, and Naval Gun Factory); and the Panama Canal.

Besides the metallurgical division of the Bureau of Standards, sections of other divisions dealing with electrochemistry, engineering mechanics, magnetic measurements, metal and ore analysis, thermal expansivity, and pyrometry were represented. The total number in attendance was about 100—80 at the ferrous session May 6 and 65 at the nonferrous sessions May 7. Of those outside the Bureau of Standards, 20 were present on both days.

The meeting was opened by Doctor Burgess, who recalled that the Metallurgical Advisory Committee was one of the oldest of the various advisory committees which help so greatly in guid-

ing the bureau in its attempts to be of service to science and industry. He stated that the sound advice received in these meetings from the representatives of the great technical societies dealing with metallurgical problems and from representatives of the metallurgical industry was no small factor in whatever measure of success was being achieved.

Prof. G. B. Waterhouse presided at the ferrous sessions and W. H. Bassett at the nonferrous.

The various research projects in metallurgy were briefly reviewed. Many charts and exhibits of specimens were used in bringing out the high spots of the work to date. The problems which were discussed at greatest length by the committee were: Wear and wear testing, corrosion and corrosion testing, high-temperature properties of metals, prevention of embrittlement of duralumin, gases in metals, abnormal steel, endurance properties of rail steel, high-speed steel and machinability, properties of pure metals, preparation of circulars of information, and methods for meeting the demand of the members of the metallurgical division

for better facilities for advanced study of metallurgy than are now available in Washington. The plans for continuation of work along these lines evoked active discussion, and were unanimously approved by the committee.

THERMAL EXPANSION OF NICKEL STEELS

An investigation on the thermal expansion of nickel steels has been started to determine which nickel steels have a wider useful temperature range than that characteristic of invar. There is considerable interest in this subject in connection with thermostatic devices.

Data on the linear thermal expansion of some nickel steels containing from 36 to 42 per cent nickel have been obtained for various temperature ranges between room temperature and 500° C. The expansion curve of each steel showed a critical point by an abrupt increase in the rate of expansion. The nickel steels containing from 36.4 to 42.2 per cent nickel expand less than invar for the temperature range from 20 to 500° C. The following table gives some of the results obtained:

Nickel content	Critical point	Average coefficients of expansion per degree Centigrade.			Nickel content	Critical point	Average coefficients of expansion per degree Centigrade.		
		20 to 100° C.	20° C. to critical point	Critical point to 500° C.			20 to 100° C.	20° C. to critical point	Critical point to 500° C.
	° C.	$\times 10^{-6}$	$\times 10^{-6}$	$\times 10^{-6}$		° C.	$\times 10^{-6}$	$\times 10^{-6}$	$\times 10^{-6}$
35.7.....	210	1.5	2.3	14.0	38.4.....	300	3.1	3.5	14.4
36.4.....	260	2.8	3.1	14.4	41.0.....	340	5.3	5.1	14.2
36.9.....	260	2.3	3.3	14.7	42.2.....	340	6.0	5.5	13.6

Additional data on these and other nickel steels will be published later in a scientific paper of this bureau. This paper when completed should answer many questions that arise in regard to the expansion of invar and other nickel steels.

CHANGES IN WEIGHTS WITH CHANGES IN HUMIDITY

The investigation of the changes in gold-plated weights accompanying changes in atmospheric humidity is practically completed. Both the cause

and the remedy have been noted in items published in previous numbers of the Bulletin and reports have been sent to American manufacturers of such weights. A paper on the work was presented before the American Physical Society at its April meeting.

In taking up again the changes in lacquered weights caused by these changes in atmospheric humidity, the weights recently submitted for regular test have furnished interesting data showing differences between weights ap-

parently alike and in showing continuous graduation from those which are entirely satisfactory to those which are too variable for certification of corrections.

It is planned to secure as much information as possible from the manufacturers concerning differences in their weights, as this may help the bureau to concentrate its investigation upon the most important phases of the subject.

BUSINESS PRECISION TEST FOR WATCHES

A new test for watches, to be known as the Business Precision Test, has been arranged, and the certificate and report forms have been prepared for printing. This test is intended especially for small size, commercial watches which ordinarily do not meet the tolerances of the Railroad Precision Test. This test will last 15 days, and will consist of a determination of the daily rates of the watch in three positions and at three temperatures. The fee will be \$2.50 per watch.

The bureau will not be prepared to test watches under the new arrangement till the certificate forms have been printed, which will probably be in about two months.

FIRE HAZARDS FROM SMOKING

In the work which the bureau is conducting on the fire hazard of matches and smoking 205 ignition tests were made during April with cigars of typical sizes. The results indicate a somewhat lower hazard than for cigarettes. The latter, when once ignited, will generally burn up completely, while cigars will go out in about one-fourth the time required for completely consuming cigarettes, and only from one-half to three-fourths inch of the cigar will be burned. When placed on pads of combustible materials with applied air currents of 2 to 9 miles per hour, the percentage ignition was also considerably lower with burning cigars than with cigarettes.

SIMPLIFICATION OF BOLT AND NUT CONTAINERS

At a general conference held at the Department of Commerce on March 23

the manufacturers, distributors, and users of machine and carriage bolts, adopted a program of packaging which calls for 18 standard-size containers. It was brought out in the conference that by adopting standard-size packaging of the nuts and bolts many economies would result not only to the manufacturers, but also from the warehousing of these articles. This program will remain in effect for a period of one year beginning July 1, 1927.

A standing committee of the industry was appointed at the conference to watch the results of the adoption of the 18 standard-size containers, and to make a report at the end of the year on any changes or modification needed in the program to make it more effective for the industry.

SIMPLIFICATION OF BILLET STOCK FOR CONCRETE REINFORCEMENT

The current intermediate grade of the American Society for Testing Materials was adopted as the single standard grade of new billet stock for concrete reinforcement at a general conference held under the auspices of the National Committee on Metals Utilizations on Saturday, March 19, 1927.

The conference was attended by 50 representatives of manufacturers, distributors, consumers, and engineers interested in steel reinforcement for concrete. W. Chatten Wetherill, director of the National Committee on Metals Utilization, presided over the meeting.

Mr. Lindau, chairman of the Grade of Steel Committee, which has been conducting the survey of current practice during the past year presented the committee's report. It was the sense of the meeting that a single grade of new billet stock was desirable for concrete reinforcement. The discussion that followed developed that the majority of demand of the country was concentrated on the intermediate grade. For this reason the conference adopted this grade as standard for a period of one year, at the end of which time a similar general conference will be held to discuss the success of the program.

Mr. Wetherill was authorized to appoint a steering committee made up of representatives of all interests to sponsor the project. This committee is to cooperate as far as possible with the American Society for Testing Materials.

SIMPLIFIED INVOICE FORM

The new simplified invoice form which was unanimously adopted on February 6, 1927, and which combines the best features of both the uniform and the National Standard invoice forms deserves the most earnest consideration of all printers and users of commercial forms. It has been agreed that the details of the simplified invoice will be reconsidered at the end of two years, thus insuring that it will continue to be the best invoice available for use in the field of industrial distribution. A facsimile of the new form is being mailed out to all interests for acceptance. As soon as the required number of acceptances are received a revision of Simplified Practice Recommendation No. 37 for commercial forms will be printed.

MANAGEMENT WEEK

Last year's Management Week, held October 25 to 30, 1926, met with nationwide support from business men, managers, engineers, and other executives. Out of the 116 cities in which the effort was successful 64 reported 252 meetings, with aggregate attendance of over 30,000, who listened to and discussed reports of progress in waste elimination.

The national organization sponsoring the 1926 Management Week was made up of the American Society of Mechanical Engineers, the Society of Industrial Engineers, the American Management Association, the Taylor Society, and the American Institute of Accountants. This same group is sponsoring the 1927 Management Week, scheduled for October 24 to 29. To this group will be added the National Association of Purchasing Agents, the National Foremen's Association, and possibly some others also of widely recognized importance in the business world.

The theme for Management Week, October 24 to 29, 1927, is "Management's Part in Maintaining Prosperity" and is designed to focus nation-wide attention, particularly of those concerned with management problems, on their individual and collective responsibility to contribute to the continuance of prosperity for our country and its people.

Executives of every kind—corporation presidents, plant managers, engineers, accountants, comptrollers, purchasing agents, sales managers, shop foremen, credit managers, merchants, and others—who have any responsibility for the efficient and profitable operation of American business enterprises should find in this program an opportunity to demonstrate from their own experiences what policies, procedures, and practices will help most to hold our prosperity at its present high level. If this can be done and if the gains made in recent years consolidated against recession, a sound basis will have been established for an advance to even higher levels in the years immediately ahead.

The National Committee on Management Week 1927 strongly urge all executives to support this movement, by co-operating with their local committee, by attending and participating in local meetings, and by encouraging greater public interest in the causes for prosperity and the conditions which will maintain it.

The first Management Week was held in 1922 under the auspices of the management division of the American Society of Mechanical Engineers, the Taylor Society, and the Society of Industrial Engineers. Since then it has been repeated each year with steadily increasing interest, approval, and support—last year's response being double that of 1925.

This year, as last, the national secretary is Ray M. Hudson, chief of the division of simplified practice. Mr. Hudson is a member of the Taylor Society and also a member of the Advisory Board of the Society of Industrial Engineers.

SAVI

The
condu
amou
indus
of sim
Inqui
cepto
which
year.
cover
imou
pract
It is
lars
The
sente
as 50
and
as m

THI

Ci
Stan
1921
Spec
Tire
thes
in c
tion
gate
on I
depa
men
tion
The
25,
ing
and
erat
com
Boa
Am
deta
dur
sur
cha
am
ma
the

SAVINGS THROUGH SIMPLIFICATION

The division of simplified practice is conducting a survey to determine the amount of actual benefit derived by the industries from the practical operation of simplified practice recommendations. Inquiries are being directed to all acceptors of simplified practice schedules which have been in effect more than one year. The replies thus far received, while covering only four commodities, are unanimous in their indorsement of simplified practice as a waste-elimination measure. It is naturally difficult to arrive at "dollars and cents" estimates of savings. The few figures which have been presented show economies ranging as high as 50 per cent of the production costs and inventory reductions amounting to as much as \$140,000 for a single company.

THIRD REVISION OF SPECIFICATION FOR TIRES AND TUBES

Circular No. 115 of the Bureau of Standards was first printed October 27, 1921, under the title "Recommended Specifications for Pneumatic Tires, Solid Tires, and Inner Tubes." A revision of these specifications, which was prepared in cooperation with the Rubber Association of America, was officially promulgated by the Federal Specifications Board on February 3, 1922, for the use of the departments and independent establishments of the Government. The specification has since been revised three times. The last revision, promulgated on April 25, 1927, was made to meet the increasing demands for pneumatic truck tires and balloon tires. As a result of cooperative work between the rubber products committee of the Federal Specifications Board and the Rubber Association of America, the specification now provides detailed requirements, including an endurance test, for all sizes of high-pressure and balloon tires. Government purchases of tires and inner tubes, which amount to about \$1,500,000 a year, are made on the basis of tests conducted at the Bureau of Standards.

IMPROVEMENT OF SKEIN TEST FOR STRENGTH OF YARNS

In the skein test for breaking yarns, 120 yards of yarn are first wound on a reel $1\frac{1}{2}$ yards in diameter. This skein, consisting of 80 strands, is then placed on drums in the testing machine and broken. Some modifications of this test have been suggested, notably the proposed method of the American Society for Testing Materials for testing rayon. This method requires that a segment of the skein be cut from it, the yarns made as nearly parallel as possible, and broken in the jaws of the testing machine in a manner similar to the strip test for cloth.

The bureau has developed an improvement on the skein test as follows: The yarns are wound with controlled tension around an elongated U-shaped rod of sufficient diameter to permit the insertion of a transfer clamp between the two layers of yarns. Using the clamp, the yarns are inserted between the jaws of the testing machine, after which the clamp is removed.

The advantages of this method are that the yarn is tensioned equally and this tension is preserved until the start of the test. Consistent results have been obtained, especially with stress-strain curves.

MANGROVE BARK AS TANNING MATERIAL

A copy of United States Consular Report No. 242157, relating to the production of mangrove bark in Portuguese East Africa, was sent to the bureau by the State Department, together with samples of the bark for analysis. Mangrove bark yields an abundance of tanning matters suitable for use in the manufacture of heavy leathers, such as sole. It is found in large quantities in the tropical belt all around the world and offers a profitable source of tanning materials. During the last 10 years the use of mangrove bark extract by American tanners has shown a steady increase.

The above-mentioned bark was very thick and reddish in color. When extracted with water at a temperature of 90° C., it yielded 61.8 per cent of soluble solids on a dry basis. The bark contained 3.8 per cent moisture and 46 per cent of tanning matters of very red color which could be considerably moderated by blending with other vegetable materials. The pH value of a solution of analytical strength was 3.86.

CLASSIFICATION OF PAPER FREIGHT-CONTAINER BAGS

The improvement in the quality of paper bags and the development of the multiple-wall type have led during recent years to a continually increasing use of such containers for shipping powdered materials by freight. This has directed considerable attention to the requirements for paper bags in the Consolidated Freight Classification.

The Bureau of Standards, at the request of and in cooperation with a paper-bag manufacturer, has just completed a series of tests on the relative strength of single-wall and double-wall bags. This was in connection with section 10, rule 40, of the Consolidated Freight Classification which requires that a multiple-wall bag shall contain a greater total weight of paper than a single-wall bag, when the two types of bags are used for a similar purpose.

Two sets of satchel-bottom, pasted, kraft bags were used in making the comparison. A one-eighth-barrel bag made of a single layer of 100-pound paper was compared for strength with a one-eighth-barrel bag composed of two sheets of 50-pound kraft paper. A similar comparison was made between a one-fourth-barrel bag made of two layers of 60-pound paper and a one-fourth-barrel bag made of one sheet of 120-pound paper.

The test adopted was repeated dropping, two types of such test being used—the side drop and the end drop. The side drop was a 4-foot drop with the bag in a horizontal position. The end drop was a 2-foot drop, the bag being placed in a vertical position with the

tied end uppermost. In both types the bag was filled with 25 or 50 pounds of flour, according to its capacity. The apparatus used for dropping the bag was a double trapdoor of adjustable height. The release of two sets of sliding bolts caused the bags to fall to a cement floor. This was repeated until the bags were broken. The bursting strength and weight of the paper composing the bags were determined and taken into account in comparing the results obtained.

When subjected to the dropping test, which is generally considered to simulate best the service strains to which bags are subjected, the double-wall bags showed from 18 to 100 per cent greater resistance to the dropping impact than the single-wall bags. These tests show conclusively that double-wall bags are stronger than single-wall bags when the two are of the same type and of the same weight of paper.

A report giving these findings was submitted to the Official Freight Classifications Board relative to proposed revision of the section of the Consolidated Freight Classification mentioned. The revised section would permit equal weights of paper for single-wall and double-wall bags.

The experience obtained in this work indicates that the chief factors in the serviceability of freight-container paper bags are, in addition to the strength of the paper, the relative dimensions of the two sides of the bags, the amount of space remaining in the bags after they are filled, and the manner of closing the bottom seams or folds. Additional experimentation on these factors, including the various types of bags as regards both construction and kind of paper, would no doubt lead to information of value, both in more adequately classifying the bags and increasing their serviceability.

WORKABILITY OF CONCRETE

In the preparation of the concrete test cylinders from 32 Portland cements used in a recent investigation at the bureau it was observed that, for the same

amounts of water and cement and the same proportion and quantities of aggregate, some of the cements produced a concrete of relatively greater workability than others. Personal judgments of the relative workability of each batch were given by both of the laboratory workers who mixed the batches by hand and by the operator who rodded the concrete in the cylinder molds. Two batches were prepared from each cement on each of three different days, each of the two mixers preparing one-half of the number of batches. At the time of preparation no reference was made to the notes of preceding days, and therefore the opinions may be considered as impartial. The mixture was quite stiff, with a slump between approximately 0 and $\frac{1}{2}$ inch, the water cement ratio being 0.9. The mix was considerably oversanded. The flow was measured on the flow table, using 15 drops of $\frac{1}{2}$ inch. The following figures on nine random concretes, made from cements selected according to their general allocation by judgment into relatively dry, medium, or wet mixes, are of interest.

	Group								
	Dry			Medium			Wet		
Cement...	A	B	C	D	E	F	G	H	I
Flow.....	60	61	65	73	78	68	90	85	94
Average flow...	62			73			90		

A particular point of interest is that different Portland cements combined with the same proportions of identical materials, and under similar conditions, with the same ratio of water to cement will produce concretes of decidedly different workability, in so far as that property is visually apparent to the observer, by rodding the concrete or by measurements on the flow table.

The actual water-cement ratio was used without reference to any differences in the normal consistency requirements of the neat cements. An examination of the test data on the relative

normal consistency did not indicate that such differences would account for the difference in workability of the concrete.

RATE OF CARBONATION OF LIME PLASTER

One of the first facts to be recognized concerning the properties of lime is that its combination with the carbon dioxide of the air is the main reaction which leads to the formation of the bonding material of lime mortar and plaster. However, definite facts concerning the recarbonation process have not been available and an investigation has therefore been undertaken at the bureau to obtain more information on this subject. Three different variables have been given special consideration.

1. Type of mortar.—Four different types of lime were used in making up 2-inch cubes; namely, a high-calcium quicklime, a dolomitic quicklime, a high-calcium hydrated lime, and a dolomitic hydrated lime.

2. The richness of mortar.—Mortar containing three different proportions of lime and sand was made from each of the four types of lime mentioned above. The richest mortar contained 1 part of hydrated lime to each part of sand by weight; another, 1 part of hydrated lime to 3 parts of sand; and the leanest mix contained 1 part of hydrated lime to 9 parts of sand.

3. The different surface coatings of the mortar.—A sufficiently large quantity was made up of each of the 12 mixes mentioned above, so that 3 identical cubes, with surfaces as follows, could be made from each mortar: (a) Uncoated, (b) one-eighth inch of the usual white finish coat, and (c) an oil paint. At the end of definite increments of time $\frac{1}{4}$ -inch layers were removed from each of the cubes and analyzed. The results obtained to date indicate the following:

1. Richness of the mortar.—In the 1:1 mortar there was no appreciable amount of carbon dioxide inside of the second $\frac{1}{4}$ -inch layer after 120 days aging, while at the end of the same length of time a relatively large percentage of car-

bon dioxide was found in the third layer of the 1:3 mortar, and the 1:9 mortar was quite evenly carbonated throughout.

2. Surface coating.—The cubes which were not coated showed considerable carbonation at the end of 30 days and there appeared to be a fairly steady increase in the carbonation at least up to a certain limit.

The application of a $\frac{1}{8}$ -inch white coat to the surface of the cubes retarded the rate of carbonation considerably. This effect was more marked in the case of the richer mortars than in the 1:9 mortar. While the white coat of plaster undoubtedly retards the carbonation of the underlying plaster there was, nevertheless, a steady increase of the carbon dioxide content, so it may be said that this finish coat is not impervious to carbon dioxide and its effect is therefore neither permanent nor serious. The application of an oil paint to the 1:1 mortar reduced its rate of carbonation considerably below that surfaced with a white coat. However, even in this case there was a slight increase noted in carbon dioxide content at the end of each 30 days. The painting of the 1:3 and the 1:9 mortar reduced the carbonation in about the same degree as the application of the white coat, and as these two mixes represent the two extremes which may be found in lime plasters it is evident that the painting of a sand float finish will not have a serious effect upon the carbonation of the underlying plaster. However, the fact that it is possible to produce a fairly impervious film of paint on a smooth surface, such as a 1:1 mortar, would indicate that the advisability of applying an oil paint to the white coat of lime plaster before the underlying coats have completely carbonated is indeed questionable.

FURTHER INVESTIGATION OF FELDSPAR

The composition, results of fineness determinations by sieve and air analyses, softening ranges, and true specific gravi-

ties of the 19 feldspars used in this investigation were reported in Technical News Bulletin, No. 117, January, 1927. Work has since been done on the effect of feldspars on (1) relative glaze fit; (2) mechanical strength, volume shrinkage, and porosity of vitreous and semivitreous bodies; (3) thermal expansion of vitreous and semivitreous bodies.

1. In these tests semivitreous disks were made using the 19 different feldspars as the only variable component. The disks were bisque fired to cone 8, covered with glazes in which the feldspar was the only variable component, and glost fired to cone 6. Several combinations of different bodies and glazes were used, making a total of 365 specimens. Thirty quenchings were made by heating the glazed disks to 200° C. for 20 minutes and quenching in running water at 20° C. The results indicate that a high potash feldspar either in the body or glaze is conducive to crazing. The bodies and glazes containing a feldspar intermediate in K_2O-Na_2O content were more resistant to crazing. Included in these tests were bodies and glazes containing two high potash feldspars of almost identical chemical and petrographic analyses and fineness of grain. The group of bodies and glazes containing one of these high-potash feldspars crazed easily, while the group containing the other high-potash feldspar did not craze so easily. Why they should act differently has not yet been determined.

2. These tests were made on vitreous cast burs fired to cone 12 and semivitreous bodies fired to cone 8 using five selected feldspars as follows:

- (a) Commercially pure soda feldspar.
- (b) Low potash feldspar (Canadian).
- (c) Low potash feldspar (domestic blend).

(d) Intermediate K_2O-Na_2O content feldspar.

- (e) High potash feldspar.

The specimens used in these tests were 5-inch round bars $\frac{7}{8}$ -inch in diameter. The rate of heating and cooling was varied as follows:

Bur
450°
Bur
450°
Bur
450°

1-----
2-----
3-----
4-----
5-----

A.....
B.....
C.....
D.....

TH
ports
and
varia
small
factu
3-
vitre
spar,
treat
plete
FUN

TH
preh
qual
fract
their
of t
repo
some
brick
Bull

Burn A. Heat 30 hours; cooled 950—
450° C. at 50° per hour.

Burn B. Heat 30 hours; cooled 950—
450° C. at 16° per hour.

Burn C. Heat 17 hours; cooled 950—
450° C. at 50° per hour.

Burn D. Heat 17 hours; cooled 950—
450° C. at 19° per hour.

Results for each feldspar used are
tabulated in Table 1 and for each burn
in Table 2.

Table 1

Feldspar body No.	Vitreous		Semivitreous		
	Volume shrinkage	Strength	Volume shrinkage	Porosity	Strength
	<i>Per cent</i>	<i>Ft. lbs./in.³</i>	<i>Per cent</i>		<i>Ft. lbs./in.³</i>
1.....	36.0	7,500	29.5	6.8	6,500
2.....	36.3	7,400	28.9	10.0	5,300
3.....	36.4	9,200	30.5	7.1	6,400
4.....	37.5	8,800	29.2	8.8	6,000
5.....	37.2	7,900	28.6	8.2	6,200

Table 2

Burn	Vitreous		Semivitreous		
	Volume shrinkage	Strength	Volume shrinkage	Porosity	Strength
	<i>Per cent</i>	<i>Ft. lbs./in.³</i>	<i>Per cent</i>		<i>Ft. lbs./in.³</i>
A.....	37.1	7,600	27.3	9.5	6,300
B.....	35.2	7,600	30.3	7.9	5,900
C.....	36.5	7,800	29.1	8.9	5,900
D.....	36.7	8,900	30.2	8.2	6,100

The significance and industrial importance of the variations in shrinkage and porosity are questioned, because the variations caused by feldspar are so small, and would not affect the manufacture of the bulk of white-ware bodies.

3. Data indicate greater expansion of vitreous bodies containing a soda feldspar, and with a fast heat-fast cool-heat treatment. Expansion data are incomplete for semivitreous bodies.

FUNDAMENTAL QUALITIES OF SOME REFRACTORY CLAYS

This work is a continuation of a comprehensive study of the fundamental qualities of representative fire-clay refractories and individual clays used in their manufacture. The general outline of this investigation and a preliminary report on the thermal expansion of some special refractories and fire-clay brick were given in Technical News Bulletin No. 117, January, 1927. The

work has been continued by studying the elasticity, transverse strength, and thermal expansion of four clays at room temperature and at 550° C. The apparatus used for determining the elasticity and strength is described in Technical News Bulletin No. 120, April, 1927, in a report of tests on sagger clays.

The results obtained on the four clays are given in the table. Results reported under A were obtained by testing specimens of the clay fired to cone 12 and the results reported under B were obtained on specimens composed of 50 per cent clay and 50 per cent grog (of the same clay) fired to cone 15. The maximum elongation is assumed to be the maximum fiber elongation of the material at the point of rupture.

The data have particular application to the problem of the resistance of burned clay refractories to thermal spalling; that is, to failure when subjected to

sudden temperature changes. It is reasonable to assume that the resistance to spalling will be directly proportional to the modulus of rupture and inversely proportional to the modulus of elasticity and the thermal expansion. At the same time it is possible that the forces exerted as a result of thermal expansion would be sufficient to overcome the strength of the material as determined by either modulus of rupture or modulus of elasticity. Therefore, the ability to withstand failure becomes a function of the differential thermal expansion between two portions of burned material, or between two constituents of a burned material, and the maximum amount which they can stretch, assuming that the condition of strain continues for a sufficient

length of time. Although the elongation values in the table are based on the assumption that the elasticity in tension equals the elasticity in compression, when it may be less and the calculated elongation somewhat less than the actual, the data indicate sufficient difference in the thermal expansions of some of the clays to cause interstructural failure if they were combined in a refractory, since the difference in expansion greatly exceeds the maximum calculated elongation. It is hoped a further study of these qualities involving determination of the coefficient of elasticity in compression will prove of direct application in the manufacture of better refractories, but no conclusions can be drawn with the limited information now available.

	Modulus of rupture		Modulus of elasticity ¹		Maximum elongation ¹		Linear thermal expansion
	Cold	550° C.	Cold	550° C.	Cold	550° C.	20 to 550° C.
	<i>Lbs./in.²</i>	<i>Lbs./in.²</i>	<i>Lbs./in.²</i>	<i>Lbs./in.²</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Missouri semiflint.....	(A) 3,000 (B) 3,000	2,100 3,000	68 57	63 69	0.04 .05	0.03 .05	0.48 .46
Pennsylvania semiflint.....	(A) 1,200 (B) 650	1,500 650	36 14	41 16	.03 .05	.04 .04	.25 .22
Flint.....	(A) 200 (B) 120	130	3 3	4	.07 .04	.03	.39
Kentucky semiflint.....	(A) 980 (B) 560	1,600 710	23 11	32 14	.04 .05	.05 .05	.39

¹ All values to be multiplied by 10⁴.

² Modulus of rupture ÷ modulus of elasticity.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1926).

Scientific Papers¹

- S546. Magnetic reluctivity relationship; Raymond L. Sanford. Price, 5 cents.
S547. The Lovibond color system; K. S. Gibson and F. K. Harris. Price, 15 cents.

Technologic Papers¹

- T335. Thermal expansion of graphite; Peter Hidnert and W. T. Sweeney. Price, 5 cents.
T337. Soundproofing of apartment houses; V. L. Chrisler. Price, 5 cents.

Circulars¹

- C324. United States Government master specification for rope, manila. Price, 5 cents.

¹ Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico); 40 cents (foreign).

C326. United States Government master specification for rope, cotton. Price, 5 cents.

Simplified Practice Recommendations¹

R31 (2d revision). Loaded paper shot shells. Price, 5 cents.

R56. Carbon brushes and brush shunts. Price, 5 cents.

R59. Rotary-cut lumber stock for wire-bound boxes. Price, 5 cents.

Miscellaneous Publications¹

M76. Mollier chart (metric engineering units). Properties of ammonia. Price, 10 cents.

M77. Standards Yearbook, 1927. Price, \$1.

Technical News Bulletin¹

TNB 121. Technical News Bulletin, May, 1927.

OUTSIDE PUBLICATIONS²

Compressive strength and deformation of structural steel and cast-iron shapes at temperatures up to 950° C. (1,742° F.). S. H. Ingberg and P. D. Sale; Proceedings American Society for Testing Materials; Vol. 26, Part II; 1926.

Bases for specification and building code requirements for building brick. S. H. Ingberg; Proceedings Twenty-third Annual Meeting, Sand-Lime Brick Association; February, 1927.

Thermal expansion of beryllium (abstract). Peter Hidnert and W. T. Sweeney; Physical Review, Vol. 29, p. 616; April, 1927.

Intercrystalline corrosion of metals. H. S. Rawdon; Industrial and Engineering Chemistry; Vol. 19, p. 613; 1927.

Note on crystal structure of electrodeposited chromium. F. Sillers, jr.; Preprint No. 30, American Electrochemical Society; 1927.

Principles of electrolytic corrosion. W. Blum and H. S. Rawdon; Preprint No. 48, American Electrochemical Society; 1927.

Note on the ferroxyl reagent. H. S. Rawdon; Mining and Metallurgy; Vol. 8, p. 299; 1927.

Twenty-five years of nonferrous electrothermics. H. W. Gillett; Preprint No. 24, American Electrochemical Society; 1927.

Present-day motor fuels. H. K. Cummings; Automotive Daily News, April 8, 1927.

Soaps as dry-cleaning aids. C. C. Hubbard; American Dyestuff Reporter; February 21, 1927.

Removing stains from cellulose acetate rayons. M. H. Goldman and C. C. Hubbard; American Dyestuff Reporter; Vol. XVI, No. 6, p. 237; April 18, 1927.

Determination of the fiber composition of roofing felts. R. E. Lofton; Paper Trade Journal; Vol. 84, No. 14, p. 57; April 7, 1927.

Effect of various sodium silicates and other electrolytes on clay slips. S. J. McDowell; Journal of the American Ceramic Society; Vol. 10, No. 4, p. 225; April, 1927.

The Bureau of Standards and its work on sand-lime brick. J. M. Porter; Proceedings Sand-Lime Brick Association; 1927.

Doing the impossible is their job. Hugh G. Boutell; Boston Herald, p. 5; April 24, 1927.

¹ Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico); 40 cents (foreign).

² "Outside publications" are not for distribution or sale.

The first of these is the fact that the United States is a young nation, and its history is therefore a history of growth and development.

The second is the fact that the United States is a nation of immigrants, and its history is therefore a history of the struggle for a new identity.

The third is the fact that the United States is a nation of diverse peoples, and its history is therefore a history of the struggle for unity.

The fourth is the fact that the United States is a nation of free men, and its history is therefore a history of the struggle for liberty.

The fifth is the fact that the United States is a nation of progress, and its history is therefore a history of the struggle for improvement.

The sixth is the fact that the United States is a nation of peace, and its history is therefore a history of the struggle for harmony.

The seventh is the fact that the United States is a nation of justice, and its history is therefore a history of the struggle for equality.

The eighth is the fact that the United States is a nation of hope, and its history is therefore a history of the struggle for a better future.

The ninth is the fact that the United States is a nation of faith, and its history is therefore a history of the struggle for a higher purpose.

The tenth is the fact that the United States is a nation of love, and its history is therefore a history of the struggle for a more perfect union.

The eleventh is the fact that the United States is a nation of courage, and its history is therefore a history of the struggle for a more just society.

The twelfth is the fact that the United States is a nation of wisdom, and its history is therefore a history of the struggle for a more enlightened people.

The thirteenth is the fact that the United States is a nation of strength, and its history is therefore a history of the struggle for a more powerful nation.

The fourteenth is the fact that the United States is a nation of honor, and its history is therefore a history of the struggle for a more respected people.

The fifteenth is the fact that the United States is a nation of glory, and its history is therefore a history of the struggle for a more glorious future.

The sixteenth is the fact that the United States is a nation of peace, and its history is therefore a history of the struggle for a more peaceful world.

The seventeenth is the fact that the United States is a nation of justice, and its history is therefore a history of the struggle for a more just world.

The eighteenth is the fact that the United States is a nation of hope, and its history is therefore a history of the struggle for a more hopeful future.

The nineteenth is the fact that the United States is a nation of faith, and its history is therefore a history of the struggle for a more faithful people.

The twentieth is the fact that the United States is a nation of love, and its history is therefore a history of the struggle for a more loving world.

The twenty-first is the fact that the United States is a nation of courage, and its history is therefore a history of the struggle for a more courageous people.

The twenty-second is the fact that the United States is a nation of wisdom, and its history is therefore a history of the struggle for a more wise nation.

The twenty-third is the fact that the United States is a nation of strength, and its history is therefore a history of the struggle for a more powerful world.

The twenty-fourth is the fact that the United States is a nation of honor, and its history is therefore a history of the struggle for a more respected future.

The twenty-fifth is the fact that the United States is a nation of glory, and its history is therefore a history of the struggle for a more glorious world.

